US009809418B2

(12) **United States Patent**
Nagarajan et al.

(10) **Patent No.:** **US 9,809,418 B2**
(45) **Date of Patent:** **Nov. 7, 2017**

(54) **ADVANCED SMOOTH RESCUE OPERATION**

(71) Applicant: **Otis Elevator Company**, Farmington, CT (US)

(72) Inventors: **Prasanna Nagarajan**, Farmington, CT (US); **Amir Lotfi**, South Windsor, CT (US); **Edward Piedra**, Chicopee, MA (US)

(73) Assignee: **OTIS ELEVATOR COMPANY**, Farmington, CT (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **15/056,158**

(22) Filed: **Feb. 29, 2016**

(65) **Prior Publication Data**

US 2017/0247222 A1 Aug. 31, 2017

(51) **Int. Cl.**

B66B 5/06	(2006.01)
B66B 1/32	(2006.01)
B66B 13/14	(2006.01)
B66B 1/28	(2006.01)

(52) **U.S. Cl.**
CPC ***B66B 1/28*** (2013.01); *B66B 2201/34* (2013.01)

(58) **Field of Classification Search**
USPC 187/247
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,478,315 A 10/1984 Nomura
5,035,301 A 7/1991 Skalski
5,070,290 A 12/1991 Iwasa et al.
5,085,294 A 2/1992 Iwata
5,893,432 A 4/1999 Nguyen et al.
6,196,355 B1 * 3/2001 Fargo B66B 5/027 187/287
6,315,081 B1 11/2001 Yeo
6,435,312 B2 8/2002 Tajima et al.
6,802,395 B1 10/2004 Helstrom et al.
(Continued)

FOREIGN PATENT DOCUMENTS

DE 102009049267 A1 4/2011
JP 2014172761 A 9/2014

OTHER PUBLICATIONS

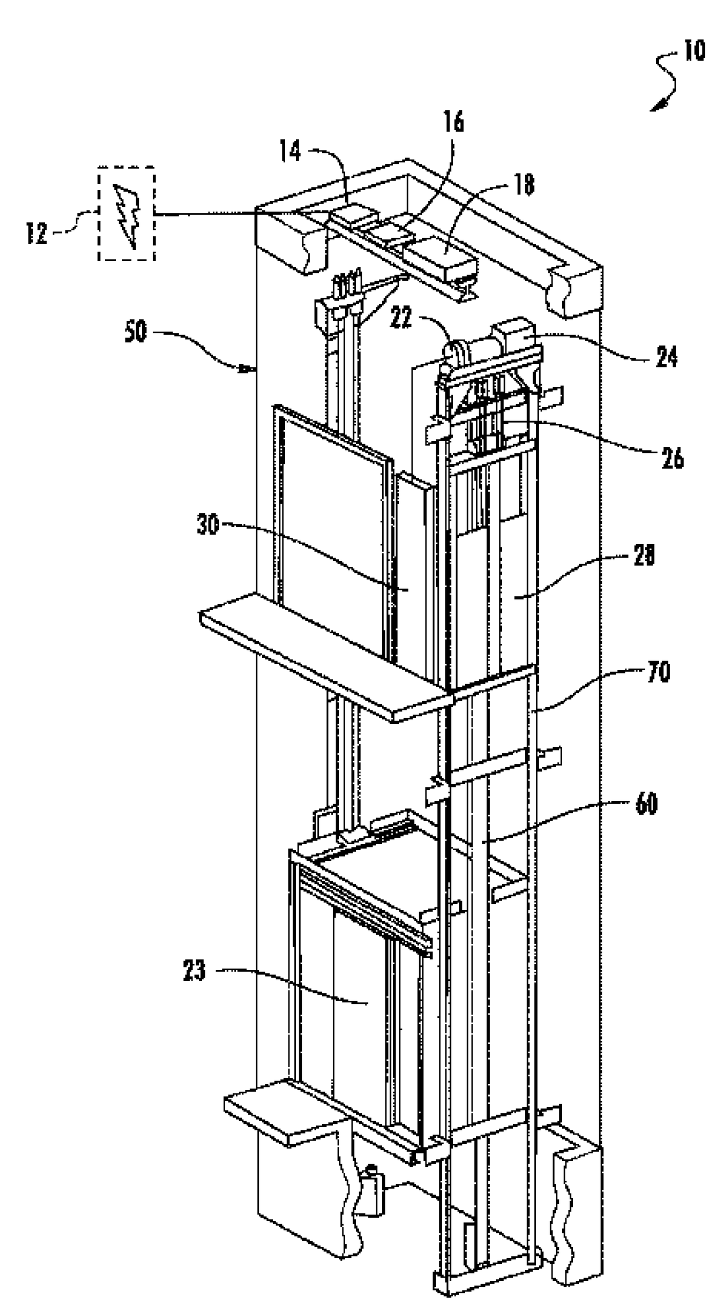
European Search Report for application EP 17157794.3, dated Jun. 26, 2017, 16pgs.

Primary Examiner — Christopher Uhlir
(74) *Attorney, Agent, or Firm* — Cantor Colburn LLP

(57) **ABSTRACT**

According to one embodiment, a method of operating an elevator system is provided. The method includes detecting, using a controller, when an external power source is unavailable. The method also includes controlling, using the controller, a plurality of components of the elevator system. The controlling comprises operating at least one of an elevator car, a drive unit, an inverter and a brake. The method further includes detecting, using the controller, an original direction of travel of the elevator car. The method yet further includes detecting, using the controller, a mode of the elevator car, wherein the mode includes at least one of a motoring mode, a near balance mode, and a regenerative mode. The method includes determining, using the controller, a target floor. The method also includes adjusting, using the controller, a velocity of the elevator car to reach the target floor in response to the mode detected.

4 Claims, 5 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

7,686,139	B2 *	3/2010	Kondo	B66B 1/32 187/277
7,775,330	B2	8/2010	Kattainen et al.	
7,921,969	B2 *	4/2011	Stolt	B66B 1/30 187/293
7,931,127	B2 *	4/2011	Kondo	B66B 1/32 187/277
7,967,113	B2	6/2011	Smith et al.	
8,267,224	B2	9/2012	Gremaud et al.	
8,789,659	B2	7/2014	Agirman et al.	
8,869,945	B2	10/2014	Härkönen et al.	
9,227,815	B2	1/2016	Martinelli et al.	
2008/0073157	A1 *	3/2008	Kanon	B66B 5/027 187/290
2011/0120810	A1 *	5/2011	Schroeder-Brumloop	B66B 5/027 187/290
2015/0353321	A1	12/2015	Fargo	

* cited by examiner

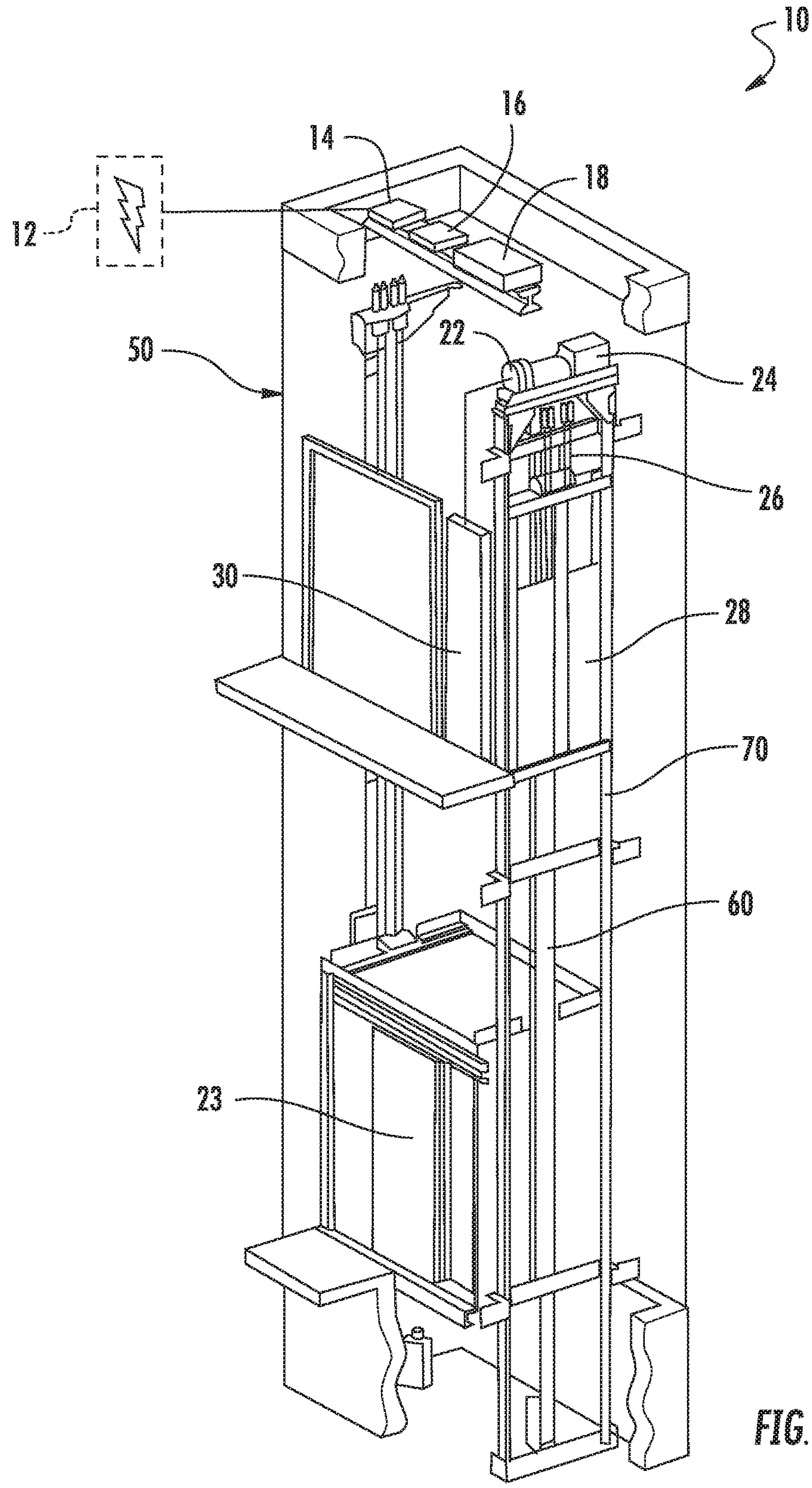


FIG. 1

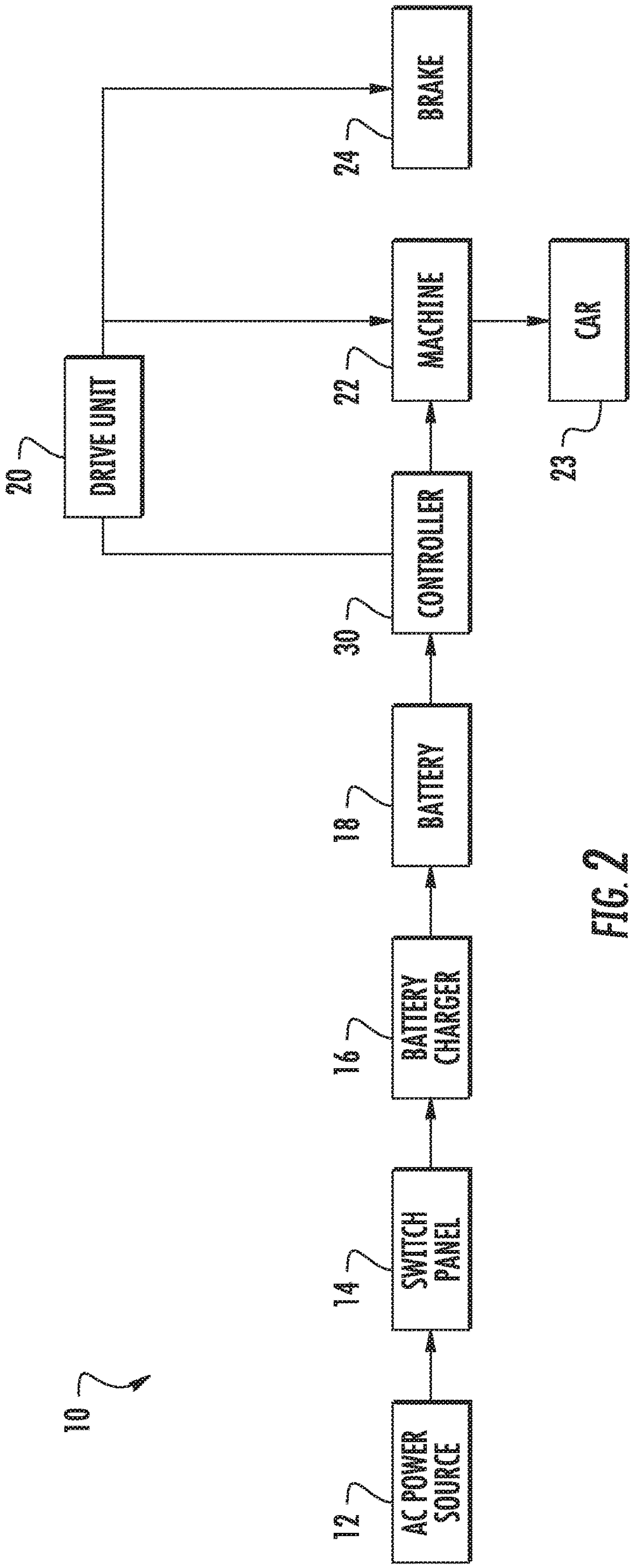

10
12
AC POWER SOURCE
14
SWITCH PANEL
16
BATTERY CHARGER
18
BATTERY
30
CONTROLLER
20
DRIVE UNIT
22
MACHINE
23
CAR
24
BRAKE

FIG. 2

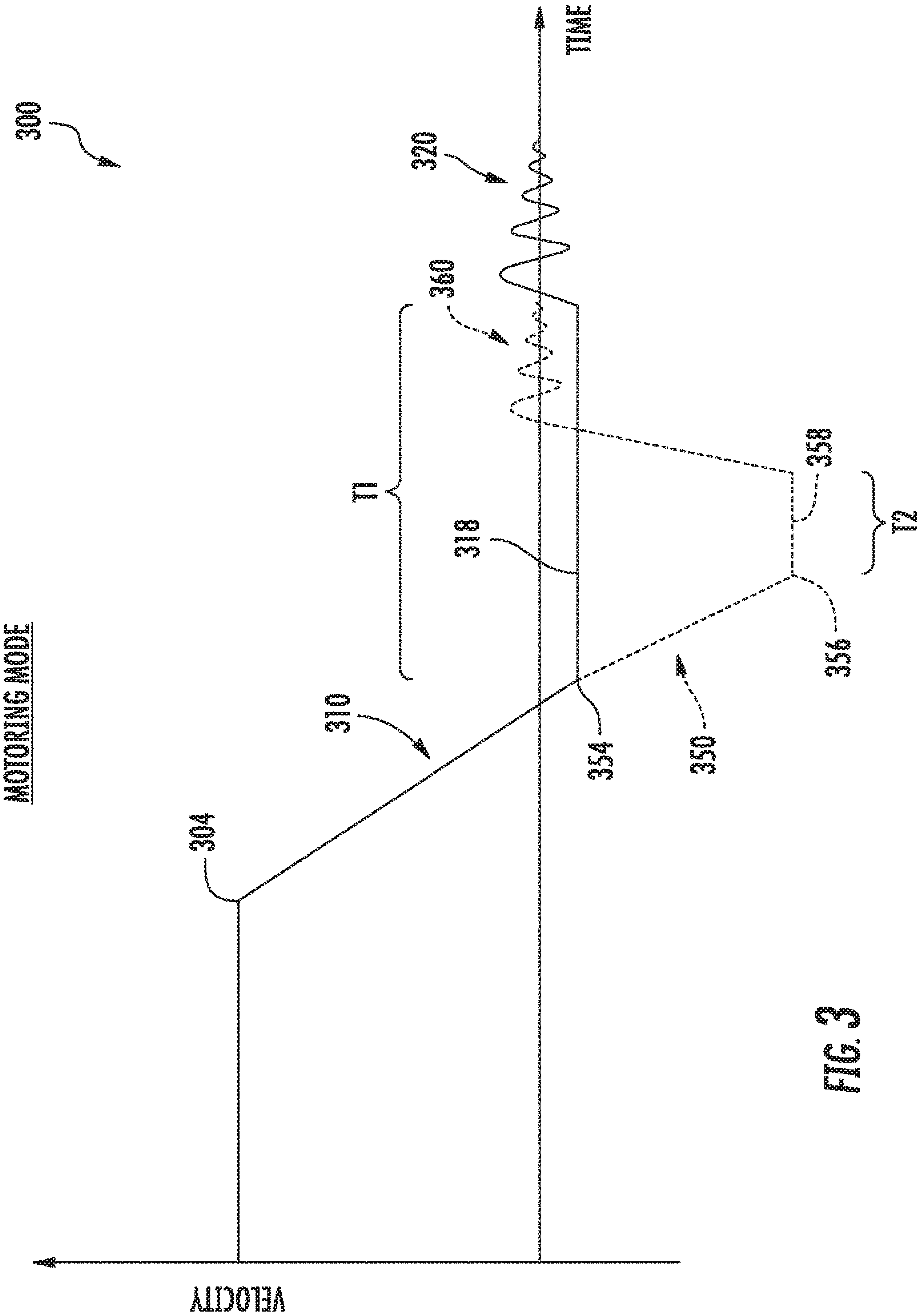

300
MOTORING MODE
TIME
VELOCITY
304
310
318
320
350
354
356
358
360
T1
T2

FIG. 3

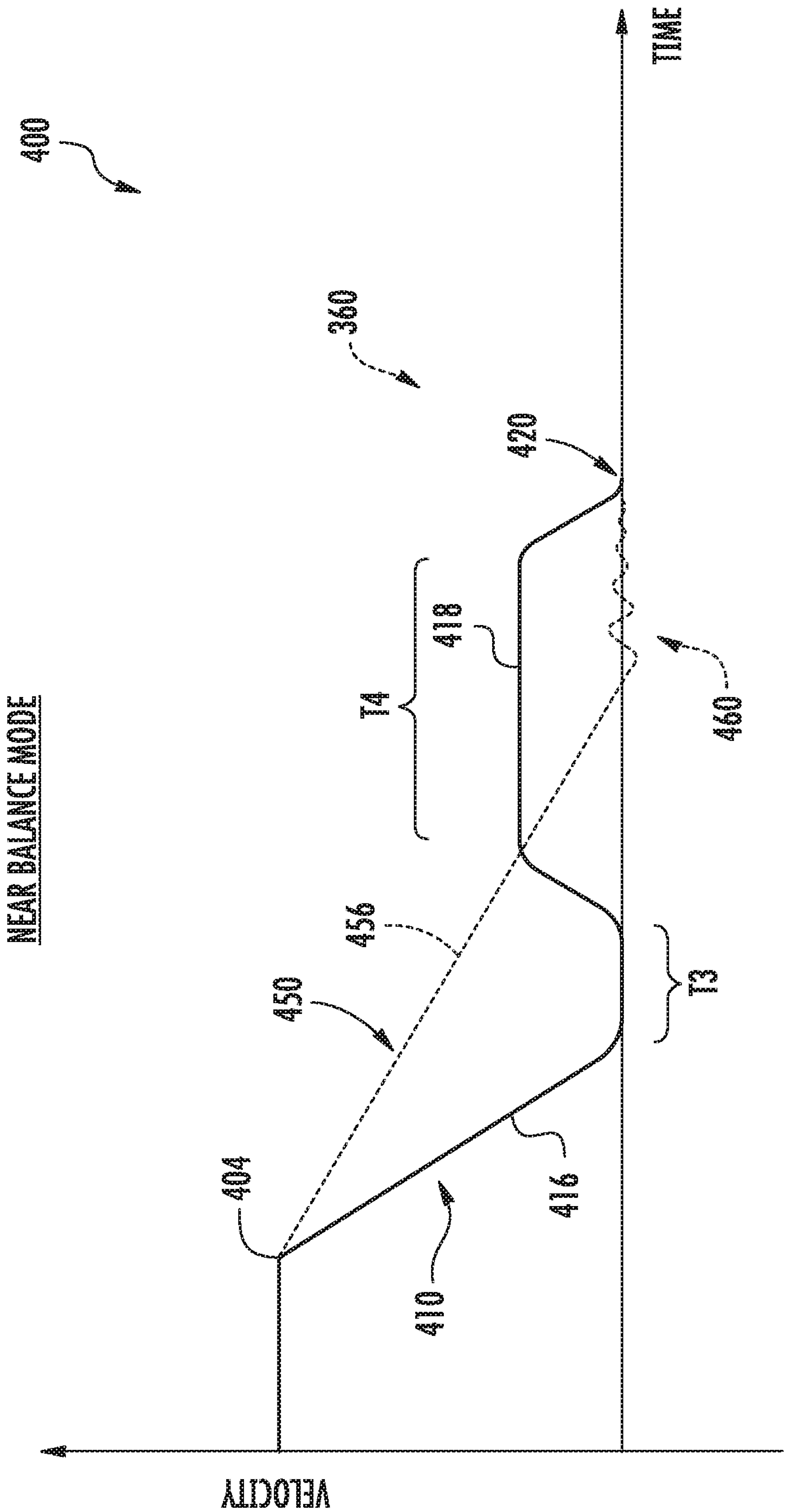

NEAR BALANCE MODE
400
TIME
360
420
418
T4
460
456
450
T3
404
416
410
VELOCITY

FIG. 4

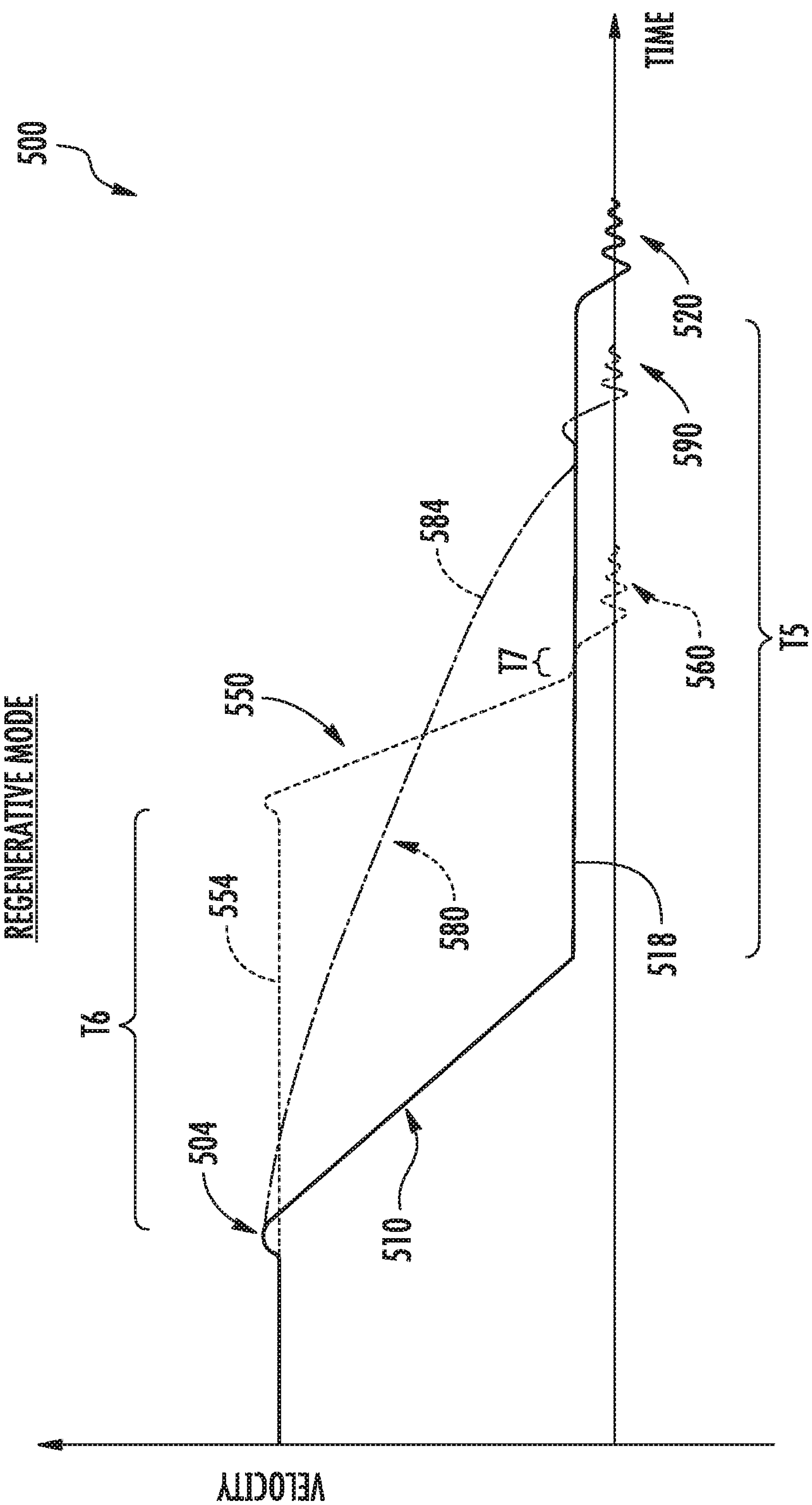

500
REGENERATIVE MODE
TIME
VELOCITY
550
554
T6
504
510
580
584
T7
560
590
520
518
T5

FIG. 5

ADVANCED SMOOTH RESCUE OPERATION

BACKGROUND

The subject matter disclosed herein relates generally to the field of elevator systems, and specifically to a method and apparatus for bringing an elevator to a controlled stop when power from an external power source is unavailable.

A typical elevator system includes a car and a counterweight disposed within a hoistway, a plurality of tension ropes that interconnect the car and counterweight, and a drive unit having a drive sheave engaged with the tension ropes to drive the car and the counterweight. The ropes, and thereby the car and counterweight, are driven by rotating the drive sheave. Traditionally, the drive unit and its associated equipment were housed in a separate machine room.

Newer elevator systems have eliminated the need for a separate machine room by mounting the drive unit in the hoistway. These elevator systems are referred to as machine room-less systems. Traditionally, elevator systems have been dependent on an external power source for operation, which complicates operation in the event that the external power source is unavailable.

BRIEF SUMMARY

According to one embodiment, a method of operating an elevator system is provided. The method includes detecting, using a controller, when an external power source is unavailable. The method also includes controlling, using the controller, a plurality of components of the elevator system. The controlling comprises operating at least one of an elevator car, a drive unit, an inverter and a brake. The method further includes detecting, using the controller, an original direction of travel of the elevator car. The method yet further includes detecting, using the controller, a mode of the elevator car, wherein the mode includes at least one of a motoring mode, a near balance mode, and a regenerative mode. The method includes determining, using the controller, a target floor. The method also includes adjusting, using the controller, a velocity of the elevator car to reach the target floor in response to the mode detected.

In addition to one or more of the features described above, or as an alternative, further embodiments of the method may include allowing, using the controller, the velocity of the elevator car to decrease to about zero velocity, when the motoring mode is detected; and allowing, using the controller, the velocity of the elevator car to increase in a direction opposite the original direction of travel to a selected creep velocity.

In addition to one or more of the features described above, or as an alternative, further embodiments of the method may include maintaining, using the controller, the selected creep velocity for a selected duration of time; decreasing, using the controller, the velocity of the elevator car in the direction opposite the original direction of travel, when the selected duration of time ends; adjusting, using the controller, the velocity of the elevator car as the elevator car approaches the target floor; and applying, using the controller, the brake when the elevator car is at the target floor.

In addition to one or more of the features described above, or as an alternative, further embodiments of the method may include deactivating, using the controller, the inverter when the selected creep velocity is less than a selected velocity in the direction opposite the original direction of travel; increasing, using the controller, the velocity of elevator car in the direction opposite the original direction of travel to a selected alternate creep velocity; maintaining, using the controller, the selected alternate creep velocity for a selected duration of time; decreasing, using the controller, the velocity of the elevator car in the direction opposite the original direction of travel, when the selected duration of time ends; adjusting, using the controller, the velocity of the elevator car as the elevator car approaches the target floor; and applying, using the controller, the brake when the elevator car is at the target floor.

In addition to one or more of the features described above, or as an alternative, further embodiments of the method may include determining, using the controller, a deceleration rate for the elevator car to reach the target floor, when the near balance mode is detected; allowing, using the controller, the velocity of the elevator car to decrease in accordance with the deceleration rate determined; adjusting, using the controller, the velocity of the elevator car as the elevator car approaches the target floor; and applying, using the controller, the brake when the elevator car is at the target floor.

In addition to one or more of the features described above, or as an alternative, further embodiments of the method may include allowing, using the controller, the velocity of the elevator car to decrease to a selected creep velocity, when the regenerative mode is detected; maintaining, using the controller, the selected creep velocity for a selected duration of time; decreasing, using the controller, the velocity of the elevator car to about zero, when the selected duration of time ends; adjusting, using the controller, the velocity of the elevator car as the elevator car approaches the target floor; and applying, using the controller, the brake when the elevator car is at the target floor.

In addition to one or more of the features described above, or as an alternative, further embodiments of the method may include maintaining, using the controller, the current velocity of the elevator car for a first selected duration of time, when the regenerative mode is detected; allowing, using the controller, the velocity of the elevator car to decrease to a selected creep velocity, when the first selected duration of time ends; maintaining, using the controller, the selected creep velocity for a second selected duration of time; decreasing, using the controller, the velocity of the elevator car to about zero, when the second selected duration of time ends; adjusting, using the controller, the velocity of the elevator car as the elevator car approaches the target floor; and applying, using the controller, the brake when the elevator car is at the target floor.

In addition to one or more of the features described above, or as an alternative, further embodiments of the method may include determining, using the controller, a deceleration rate for the elevator car to reach the target floor, when the regenerative mode is detected; allowing, using the controller, the velocity of the elevator car to decrease in accordance with the deceleration rate determined; adjusting, using the controller, the velocity of the elevator car as the elevator car approaches the target floor; and applying, using the controller, the brake when the elevator car is at the target floor.

According to another embodiment, an apparatus for operating an elevator system is provided. The apparatus includes an elevator car; a drive unit; an inverter; a brake; and a controller to control a plurality of components of the elevator system. The controlling comprises operating at least one of the elevator car, the drive unit, the inverter, and the brake. The controller performs operations comprising: detecting when the external power source is unavailable, detecting an original direction of travel of the elevator car, detecting a mode of the elevator car, wherein the mode includes at least one of a motoring mode, a near balance mode, and a regenerative mode, determining a target floor, and adjusting a velocity of the elevator car to reach the target floor in response to the mode detected.

In addition to one or more of the features described above, or as an alternative, further embodiments of the apparatus may include allowing the velocity of the elevator car to decrease to about zero velocity, when the motoring mode is detected; and allowing the velocity of the elevator car to increase in a direction opposite the original direction of travel to a selected creep velocity.

In addition to one or more of the features described above, or as an alternative, further embodiments of the apparatus may include maintaining the selected creep velocity for a selected duration of time; decreasing the velocity of the elevator car in the direction opposite the original direction of travel, when the selected duration of time ends; adjusting the velocity of the elevator car as the elevator car approaches the target floor; and applying the brake when the elevator car is at the target floor.

In addition to one or more of the features described above, or as an alternative, further embodiments of the apparatus may include deactivating the inverter when the selected creep velocity is less than a selected velocity in the direction opposite the original direction of travel; increasing the velocity of elevator car in the direction opposite the original direction of travel to a selected alternate creep velocity; maintaining the selected alternate creep velocity for a selected duration of time; decreasing the velocity of the elevator car in the direction opposite the original direction of travel, when the selected duration of time ends; adjusting the velocity of the elevator car as the elevator car approaches the target floor; and applying the brake when the elevator car is at the target floor.

In addition to one or more of the features described above, or as an alternative, further embodiments of the apparatus may include determining a deceleration rate for the elevator car to reach the target floor, when the near balance mode is detected; allowing the velocity of the elevator car to decrease in accordance with the deceleration rate determined; adjusting the velocity of the elevator car as the elevator car approaches the target floor; and applying the brake when the elevator car is at the target floor.

In addition to one or more of the features described above, or as an alternative, further embodiments of the apparatus may include allowing the velocity of the elevator car to decrease to a selected creep velocity, when the regenerative mode is detected; maintaining the selected creep velocity for a selected duration of time; decreasing the velocity of the elevator car to about zero, when the selected duration of time ends; adjusting the velocity of the elevator car as the elevator car approaches the target floor; and applying the brake when the elevator car is at the target floor.

In addition to one or more of the features described above, or as an alternative, further embodiments of the apparatus may include maintaining the current velocity of the elevator car for a first selected duration of time, when the regenerative mode is detected; allowing the velocity of the elevator car to decrease to a selected creep velocity, when the first selected duration of time ends; maintaining the selected creep velocity for a second selected duration of time; decreasing the velocity of the elevator car to about zero, when the second selected duration of time ends; adjusting the velocity of the elevator car as the elevator car approaches the target floor; and applying the brake when the elevator car is at the target floor.

In addition to one or more of the features described above, or as an alternative, further embodiments of the apparatus may include determining a deceleration rate for the elevator car to reach the target floor, when the regenerative mode is detected; allowing the velocity of the elevator car to decrease in accordance with the deceleration rate determined; adjusting the velocity of the elevator car as the elevator car approaches the target floor; and applying the brake when the elevator car is at the target floor.

Technical effects of embodiments of the present disclosure include an elevator system having a controller to bring an elevator car to a controlled stop when power from an external power source is unavailable. Further technical effects include that the controller detects the operating mode of the elevator car and adjusts the car velocity accordingly.

The foregoing features and elements may be combined in various combinations without exclusivity, unless expressly indicated otherwise. These features and elements as well as the operation thereof will become more apparent in light of the following description and the accompanying drawings. It should be understood, however, that the following description and drawings are intended to be illustrative and explanatory in nature and non-limiting.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other features, and advantages of the disclosure are apparent from the following detailed description taken in conjunction with the accompanying drawings in which like elements are numbered alike in the several FIGURES:

FIG. **1** illustrates a schematic view of an elevator system, in accordance with an embodiment of the disclosure;

FIG. **2** is a block diagram of the elevator system of FIG. **1**, in accordance with an embodiment of the disclosure;

FIG. **3** is a velocity versus time graph illustrating the deceleration paths of an elevator car in motoring mode, in accordance with an embodiment of the disclosure;

FIG. **4** is a velocity versus time graph illustrating the deceleration paths of an elevator car in near balance mode, in accordance with an embodiment of the disclosure; and

FIG. **5** is a velocity versus time graph illustrating the deceleration paths of an elevator car in regenerative mode, in accordance with an embodiment of the disclosure.

DETAILED DESCRIPTION

Referring now to FIGS. **1** and **2**. FIG. **1** shows a schematic view of an elevator system **10**, in accordance with an embodiment of the disclosure. FIG. **2** shows a block diagram of the elevator system **10** of FIG. **1**, in accordance with an embodiment of the disclosure. The elevator system **10** includes an elevator car **23** configured to move vertically upward and downward within a hoistway **50** along a plurality of car guide rails **60**. The elevator system **10** also includes a counterweight **28** operably connected to the elevator car **23** via a pulley system **26**. The counterweight **28** is configured to move vertically upward and downward within the hoistway **50**. The counterweight **28** moves in a direction generally opposite the movement of the elevator car **23**, as is known in conventional elevator systems. Movement of the counterweight **28** is guided by counterweight guide rails **70** mounted within the hoistway **50**.

The elevator system **10** also includes an alternating current (AC) power source **12**, such as an electrical main line (e.g., 230 volt, single phase). The AC power is provided from the AC power source **12** to a switch panel **14**, which may include circuit breakers, meters, etc. From the switch panel **14**, the AC power is provided to a battery charger **16**, which converts the AC power to direct current (DC) power to charge a battery **18**. The battery **18** may be a lead-acid, lithium ion or other type of battery. The battery **18** may power the elevator system **10** when an external power source (e.g. AC power source **12**) is unavailable. The battery **18** may provide propulsive power and/or may serve as a backup power source to various components of the elevator system **10** including but not limited to the brakes **24**, the elevator doors, and the position reference system. Alternatively, the battery **18** may also be another power source such as, for example a capacitor, gas powered generator, solar cells, hydroelectric generator, wind turbine generator or any other similar power generation and/or storage device. The DC power flows through the controller **30** to a drive unit **20**, which contains an inverter to invert the DC power from the battery **18** to AC drive signals. The drive unit **20** drives a machine **22** to impart motion to the elevator car **23** via a traction sheave of the machine **22**. The AC drive signals may be multiphase (e.g., three-phase) drive signals for a three-phase motor in the machine **22**. The machine **22** also includes a brake **24** that can be activated to stop the machine **22** and elevator car **23**.

The inverter within the drive unit **20** converts DC power from battery **18** to AC power for driving machine **22** in motoring mode. Motoring mode refers to situations where the machine **22** is drawing current from the drive unit **20**. For example, motoring mode may occur when an empty elevator car is traveling downwards or a loaded elevator car is traveling upwards. The inverter of the drive unit **20** also converts AC power from machine **22** to DC power for charging battery **18** when operating in regenerative mode. Regenerative mode refers to situations where the drive unit **20** receives current from the machine **22** (which acts as a generator) and supplies current back to the AC power source **12**. For example, regenerative mode may occur when an empty elevator car is traveling upwards or when a loaded elevator car is traveling downwards. There is also a near balance mode when the weight of the elevator car **23** is about balanced with the weight of the counterweight **28**. Near balance mode operates similarly to motoring mode because the machine **22** is drawing current from the drive unit **20** to move the elevator car **23** out of the balance. As will be appreciated by those of skill in the art, motoring mode, regenerative mode, and near balance mode may occur in more than just the few examples described above and are within the scope of this disclosure.

The controller **30** is responsible for controlling the operation of the elevator system **10**. The controller **30** may detect the original direction of travel of the elevator car **23**. The controller **30** may also detect a mode of the elevator car **23**. The mode may include at least one of a motoring mode, a near balance mode, and a regenerative mode, as previously described. The controller **30** may detect when the external power source **12** is unavailable. In the event the external power source **12** is unavailable, the controller **30** is responsible for determining a target floor and adjusting the velocity of the elevator car **23** to reach the target floor in response to the mode detected. The controller **30** may include a processor and an associated memory. The processor may be but is not limited to a single-processor or multi-processor system of any of a wide array of possible architectures, including field programmable gate array (FPGA), central processing unit (CPU), application specific integrated circuits (ASIC), digital signal processor (DSP) or graphics processing unit (GPU) hardware arranged homogenously or heterogeneously. The memory may be but is not limited to a random access memory (RAM), read only memory (ROM), or other electronic, optical, magnetic or any other computer readable medium.

Referring now also to FIG. **3**, which shows a velocity versus time graph **300** illustrating the deceleration paths of an elevator car **23** in motoring mode, in accordance with an embodiment of the disclosure. FIG. **3** displays two deceleration options including a first path **310** and a second path **350** for the controller **30** to follow in the event external power is unavailable **304** while in motoring mode. The controller **30** will first detect the mode of the elevator car **23**, which is motoring mode for FIG. **3**. In the event external power is unavailable **304**, on the first path **310** the controller **30** may allow the velocity of the elevator car **23** to decrease to about zero velocity. The controller **30** may utilize various methods including but not limited to back-emf braking and gravity to help decelerate. The controller **30** then allows the velocity of the elevator car **23** to increase in a direction opposite the original direction of travel to a selected creep velocity **318**. For example, if an elevator car **23** was motoring up fully loaded with passengers, the controller **30** may let gravity bring the elevator car **23** to a halt (zero velocity) and then let it start to descend. The controller **30** maintains the selected creep velocity **318** for a selected duration of time T**1**. When the selected duration of time T**1** ends, the controller **30** decreases the velocity of the elevator car **23** in the direction opposite the original direction of travel. Then at **320**, the controller adjusts the velocity of the elevator car **23** as the elevator car **23** approaches the target floor and applies the brake **24** when the elevator car **23** is at the target floor.

The controller **30** may choose a second path **350** to follow, if at point **354** the selected creep velocity is less than a selected velocity in the direction opposite the original direction of travel. For the second path **350**, the controller **30** deactivates the inverter at point **354** and increases the velocity of elevator car **23** in the direction opposite the original direction of travel to a selected alternate creep velocity **358**. At **356**, the controller **30** maintains the selected alternate creep velocity **358** for a selected duration of time T**2** and then proceeds to decrease the velocity of the elevator car **23** in the direction opposite the original direction of travel. Then at **360**, the controller adjusts the velocity of the elevator car **23** as the elevator car **23** approaches the target floor and applies the brake **24** when the elevator car **23** is at the target floor.

Referring now also to FIG. **4**, which shows a velocity versus time graph **400** illustrating the deceleration paths of an elevator car **23** in near balance mode, in accordance with an embodiment of the disclosure. FIG. **4** displays two deceleration options including a first path **410** and a second path **450** for the controller **30** to follow in the event of external power is unavailable **404** while in near balance mode. The controller will first detect the mode of the elevator car **23**, which is near balance mode for FIG. **4**. In the event external power is unavailable **404**, on the first path **410** the controller **30** may allow the velocity of the elevator car **23** to decrease to about zero velocity at **416**. The controller **30** may utilize various methods including but not limited to back-emf braking and gravity to help decelerate. The controller **30** maintains about zero velocity for a selected duration of time T**3** and then the controller **30** increases the velocity of the elevator car **23** in the original direction of travel until it reaches an automatic rescue operation (ARO) velocity **418**. The controller **30** maintains the ARO velocity for a second selected duration of time T**4**. Then at **420**, the controller **30** decreases the velocity of the elevator car **23** as it approaches the target floor and applies the brake **24** when the elevator car **23** arrives at the target floor.

The controller **30** may choose a second path **450** to follow in near balance mode. On the second path **450**, after external power is unavailable at **404** the controller **30** determines a deceleration rate for the elevator car **23** to reach the target floor. The controller **30** then allows the velocity of the elevator car **23** to decrease in accordance with the deceleration rate determined at **456**. The controller **30** may utilize various methods include including but not limited to back-emf braking and gravity to help decelerate. Then at **460**, the controller **30** adjusts the velocity of the elevator car **23** as the elevator car **23** approaches the target floor and applies the brake **24** when the elevator car **23** is at the target floor.

Referring now also to FIG. **5**, which shows a velocity versus time graph **500** illustrating the deceleration paths of an elevator car **23** in regenerative mode, in accordance with an embodiment of the disclosure. FIG. **5** displays three deceleration options including a first path **510**, a second path **550**, and a third path **580** for the controller **30** to follow in the event of external power is unavailable at **404**. The controller **30** will first detect the mode of the elevator car **23**, which is regenerative mode for FIG. **5**. In the event external power is unavailable **504**, on the first path **510** the controller **30** allows the velocity of the elevator car **23** to decrease to a selected creep velocity **518**, when the regenerative mode is detected. The controller **30** may utilize various methods including but not limited to back-emf braking and gravity to help decelerate. Then controller **30** maintains the selected creep velocity for a selected duration of time T**5** and then decreases the velocity of the elevator car **23** to about zero when the selected duration of time T**5** ends. Next at **520**, the controller adjusts the velocity of the elevator car **23** as the elevator car **23** approaches the target floor and applies the brake **24** when the elevator car **23** is at the target floor.

The controller **30** may choose a second path **550** to follow in regenerative mode. On the second path **550**, after external power is unavailable **504** the controller **30** maintains the current velocity of the elevator car **23** for a first selected duration of time T**6** at **554**, when the regenerative mode is detected. The controller **30** then allows the velocity of the elevator car **23** to decrease to a selected creep velocity, when the first selected duration of time T**6** ends. The controller **30** may utilize various methods including but not limited to back-emf braking and gravity to help decelerate. Next, the controller **30** maintains the selected creep velocity for a second selected duration of time T**7** and then decreases the velocity of the elevator car **23** to about zero, when the second selected duration of time T**7** ends. Then at **560**, the controller **30** adjusts the velocity of the elevator car **23** as the elevator car **23** approaches the target floor and applies the brake **24** when the elevator car **23** is at the target floor.

The controller **30** may choose a third path **580** to follow in regenerative mode. On the third path **580**, after external power is unavailable **504**, the controller **30** determines a deceleration rate for the elevator car **23** to reach the target floor. Next, the controller **30** allows the velocity of the elevator car **23** to decrease in accordance with the deceleration rate determined at **584**. The controller **30** may utilize various methods including but not limited to back-emf braking and gravity to help decelerate. Then at **590**, the controller **30** adjusts the velocity of the elevator car **23** as the elevator car **23** approaches the target floor and applies the brake **24** when the elevator car **23** is at the target floor.

The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting. While the description has been presented for purposes of illustration and description, it is not intended to be exhaustive or limited to embodiments in the form disclosed. Many modifications, variations, alterations, substitutions or equivalent arrangement not hereto described will be apparent to those of ordinary skill in the art without departing from the scope of the disclosure. Additionally, while the various embodiments have been described, it is to be understood that aspects may include only some of the described embodiments. Accordingly, the disclosure is not to be seen as limited by the foregoing description, but is only limited by the scope of the appended claims.

What is claimed is:

1. A method of operating an elevator system, the method comprising:

detecting, using a controller, when an external power source is unavailable;

controlling, using the controller, a plurality of components of the elevator system, wherein controlling comprises operating at least one of an elevator car, a drive unit, an inverter and a brake;

detecting, using the controller, an original direction of travel of the elevator car;

detecting, using the controller, a mode of the elevator car, wherein the mode includes at least one of a motoring mode, a near balance mode, and a regenerative mode;

determining, using the controller, a target floor; and

adjusting, using the controller, a velocity of the elevator car to reach the target floor in response to the mode detected; allowing, using the controller, the velocity of the elevator car to decrease to about zero velocity, when the near balance mode is detected; maintaining, using the controller, the about zero velocity for a selected duration of time; increasing, using the controller, the velocity of the elevator car in the original direction of travel until it reaches an automatic rescue operation velocity; maintaining, using the controller, the automatic rescue operation velocity for a second selected duration of time; and decreasing, using the controller, the velocity of the elevator car as the elevator car approaches the target floor;

wherein secondary power is provided to the brake, elevator doors, and a positional reference system in the controller;

wherein secondary power is not provided to a drive unit to propel the elevator.

2. A method of operating an elevator system, the method comprising:

detecting, using a controller, when an external power source is unavailable;

controlling, using the controller, a plurality of components of the elevator system, wherein controlling comprises operating at least one of an elevator car, a drive unit, an inverter and a brake;

detecting, using the controller, an original direction of travel of the elevator car;

detecting, using the controller, a mode of the elevator car, wherein the mode includes at least one of a motoring mode, a near balance mode, and a regenerative mode;

determining, using the controller, a target floor;

adjusting, using the controller, a velocity of the elevator car to reach the target floor in response to the mode detected;

allowing, using the controller, the velocity of the elevator car to decrease to about zero velocity, when the motoring mode is detected;

allowing, using the controller, the velocity of the elevator car to increase in a direction opposite the original direction of travel to a selected creep velocity;

deactivating, using the controller, the inverter when the selected creep velocity is less than a selected velocity in the direction opposite the original direction of travel;

increasing, using the controller, the velocity of elevator car in the direction opposite the original direction of travel to a selected alternate creep velocity;

maintaining, using the controller, the selected alternate creep velocity for a selected duration of time;

decreasing, using the controller, the velocity of the elevator car in the direction opposite the original direction of travel, when the selected duration of time ends;

adjusting, using the controller, the velocity of the elevator car as the elevator car approaches the target floor; and

applying, using the controller, the brake when the elevator car is at the target floor.

3. An apparatus for operating an elevator system, the apparatus comprising:

an elevator car;

a drive unit;

an inverter;

a brake;

a controller to control a plurality of components of the elevator system, wherein controlling comprises operating at least one of the elevator car, the drive unit, the inverter, and the brake,

wherein the controller performs operations comprising:

detecting when an external power source is unavailable,

detecting an original direction of travel of the elevator car,

detecting a mode of the elevator car, wherein the mode includes at least one of a motoring mode, a near balance mode, and a regenerative mode,

determining a target floor, and

adjusting a velocity of the elevator car to reach the target floor in response to the mode detected; allowing, using the controller, the velocity of the elevator car to decrease to about zero velocity, when the near balance mode is detected; maintaining, using the controller, the about zero velocity for a selected duration of time; increasing, using the controller, the velocity of the elevator car in the original direction of travel until it reaches an automatic rescue operation velocity; maintaining, using the controller, the automatic rescue operation velocity for a second selected duration of time; and decreasing, using the controller, the velocity of the elevator car as the elevator car approaches the target floor

wherein secondary power is provided to the brake, elevator doors, and a positional reference system in the controller;

wherein secondary power is not provided to a drive unit to propel the elevator.

4. An apparatus for operating an elevator system, the apparatus comprising:

an elevator car;

a drive unit;

an inverter;

a brake:

a controller to control a plurality of components of the elevator system, wherein controlling comprises operating at least one of the elevator car, the drive unit, the inverter, and the brake;

wherein the controller performs operations comprising:

detecting when an external power source is unavailable;

detecting an original direction of travel of the elevator car;

detecting a mode of the elevator car, wherein the mode includes at least one of a motoring mode, a near balance mode, and a regenerative mode;

determining a target floor;

adjusting a velocity of the elevator car to reach the target floor in response to the mode detected;

allowing the velocity of the elevator car to decrease to about zero velocity, when the motoring mode is detected;

allowing the velocity of the elevator car to increase in a direction opposite the original direction of travel to a selected creep velocity;

deactivating the inverter when the selected creep velocity is less than a selected velocity in the direction opposite the original direction of travel;

increasing the velocity of elevator car in the direction opposite the original direction of travel to a selected alternate creep velocity;

maintaining the selected alternate creep velocity for a selected duration of time;

decreasing the velocity of the elevator car in the direction opposite the original direction of travel, when the selected duration of time ends;

adjusting the velocity of the elevator car as the elevator car approaches the target floor; and

applying the brake when the elevator car is at the target floor.

* * * * *